

The Cryosphere Discuss., referee comment RC3
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Reply on RC1

Jonathan Toner (Referee)

Referee comment on "Brief communication: The hidden labyrinth: deep groundwater in Wright Valley, Antarctica" by Hilary A. Dugan et al., The Cryosphere Discuss.,
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There are a few points I'd like to respond to.

"...should not be considered an exhaustive analysis of hydrological contributors in the region because it largely considers only regional freshwater systems over the near-surface brines": In the Toner et al. 2017 paper we did model the surface brine evolution, and furthermore we considered all surface waters in Wright Valley as candidates. None of these surface waters can evaporatively evolve to form a DJP brine. Our recent paper Toner et al. 2022 provides an even more comprehensive look at deep, near surface, and surface water compositions in the South Fork of Wright Valley. This more recent paper supports the unique chemistry of DJP.

Regarding the comments on surface discharges into DJP, we observed groundwater discharging east of DJP in the field, just as in Dickson et al. 2013. See the timelapse of discharge events over a month in the supplementary part of Toner et al. 2022. However, we also sampled many of these groundwater outflows, even during active outflow events, and analyzed the chemistry (unpublished unfortunately). There is no hint of any surface water contribution; the samples are pure DJP groundwater. Furthermore, these outflows have no observed connectivity to water tracks east of DJP, they simply upwell at the eastern edge the DJP playa. In my opinion, these are just groundwater outflows.

Finally, regarding the discharge events and their correlation with insolation and snowfall, the most direct correlation with DJP groundwater levels appears to be air pressure, which is the expected behavior for a confined aquifer. There is data from the DVDP 13 borehole (sorry, again unpublished) that measures air pressure and water levels in the borehole, showing a strong correlation. Harris and Cartwright presented an analysis of the same, although there are many transient features that remain a mystery. We know that surface waters are contributing to DJP from streams on the western end of DJP from the rock glacier, but their influence on the chemistry is very slight (possibly, this might explain the small nitrate component of DJP).

All this is to say that a deep groundwater interpretation for DJP presented in this paper is well supported by the evidence.